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Analysis of the dynamic stability of selected multiple stars with weak hierarchy

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Abstract

The stability of multiple systems with known orbital elements and with subsystems occupying adjacent hierarchy levels is analyzed using six stability criteria and numerical simulations of their dynamical evolution. All the stability criteria considered are in qualitative agreement with the numerical computations. Of the 16 systems studied, 11 are confirmed to be stable and five (HD 40887, HD 136176, HD 150680, HD 217675, and HD 222326) may be unstable on time scales of ~106 yr or less. The small dynamical ages of the unstable systems may indicate that they have captured components during encounters between close binaries and field or moving cluster stars. The instability could also result from the perturbation of a stable system when it approaches a massive object (star, black hole, or molecular cloud). It is possible that some of the unstable systems are remnants of small clusters or stellar groups.

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